Observations of pelagic seabirds in the waters offshore Suriname, May - July 2012

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Abstract

The pelagic seabird fauna inhabiting the waters offshore Suriname has hardly been described. Here we provide records for the occurrence of 18 pelagic seabird species. At least three of the observed seabird species represent new state records: Yellow-nosed Albatross (*Thalassarche chlororhynchos*), Band-rumped Storm-Petrel (*Oceanodroma castro*) and Red-footed Booby (*Sula sula*). Another previously undocumented seabird in Suriname observed during this survey was Bulwer's Petrel (*Bulweria bulwerii*), although this species was not verified by photographic evidence. An additional four seabird species represent the first verified (at-sea) photographic records for Suriname: Audubon's Shearwater (*Puffinus lherminieri),* Red-billed Tropicbird (*Phaethon aethereus),* Masked Booby (*Sula dactylatra)* and Pomarine Jaeger (*Stercorarius pomarinus).* The seabird (temporal) distribution and foraging concentrations of seabirds are presented for the period 20 May – 24 July 2012. Strip-transect seabird counts (13 June to 24 July 2012) revealed that the offshore seabird community in Suriname is best described as primarily a surface-feeding community, dominated by plunge-diving shearwaters. The overall seabird abundance was low (0.59 birds/km) which is consistent for tropical equatorial offshore waters. The results highlight an increase both in the relative abundance and diversity of seabirds and the mortality amongst shearwaters in late June/early July. We recommend that more monitoring be carried out in order to gain a better understanding of the status of the different seabird species that occur in this tropical equatorial offshore region.

Keywords: Guianas, Suriname, seabirds, shearwaters, distribution, surface feeding

Introduction

Few systematic seabird surveys off Suriname have been carried out with the majority of observational effort being within the coastal zones (Spaans, 2003). No dedicated offshore seabird surveys have been conducted within the last forty years (Ottema et al. 2009; Arie L. Spaans, pers. com.). The opportunity to carry out avian studies off Suriname was afforded in May 2012. The distribution of cetaceans and seabirds occurring in the waters offshore Suriname was investigated in an area of 256km^2 that was located 220-300km from the coast. The study presented here was conducted between 20 May and 24 July 2012 and describes (1) the occurrence of seabirds in offshore waters; (2) temporal changes in their presence and distribution; (3) the density of seabirds; and (4) the behaviour including some observations concerning multi-species foraging associations. This study provides baseline data for future investigations and monitoring as well as for conservation and management of seabirds in Suriname waters.

Materials and methods

The seabird observations were undertaken from the seismic survey vessel *Western Regent* with an overall length of 93.2 m. The authors boarded the vessel on 15 May in Trinidad and transited to the study area where they were present until 24 July 2012. The study area was located between 220 and 300km north of the Suriname coast (Fig. 1) and comprised water depths of 1,200-3,300m. The study area covered approximately 3,000km^2. The seismic vessel offered an observational platform with a working bridge-deck height of 14 meters allowing a good view in front and to the sides of the vessel. The vessel operated with an average speed over ground (SOG) of around 4 knots. Typical daylight hours were 06:00-19:00 Local Time. Two observers (within communication range) carried out observations of 2 hours duration during all daylight hours, with one observer monitoring ahead and to the port side of the vessel and the other observer watching ahead and to the starboard side.

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Species classification follows Remsen et al. (2013). Due to the identification challenges concerning the Audubon's (*Puffinus lherminieri*)/Little (*Puffinus assimilis*) Shearwater complex, these birds were usually recorded as Audubon's/Little Shearwater, except on the occasions where close observation precluded any doubt and allowed for specific identification to be confirmed.

Study area

Suriname is located on the northeast coast of South America, bordering the Atlantic Ocean, with French Guiana to the east, Guyana to the west and Brazil to the southeast (Figure 1). The Guianas and the Eastern Venezuelan Atlantic Front are under the influence of the Amazon River. The typical ecosystems include estuaries, mudflats, sandy beaches, and mangrove forests, which extend along most of the largely unexplored coastline (Miloslavich et al., 2011).

The present surveys took place in clear deep waters, *i.e*. from the northern boundary of the Exclusive Economic Zone at 370km offshore, up to the Continental Slope, ca 150km offshore, with some transits taking place over the continental sea in the Blue and Green Water Zones (Teunissen, 2000). The tides along the coast of Suriname are semidiurnal with tidal amplitudes ranging 1.3-2.3m. Sea surface temperatures (SST) are almost constant throughout the year (27-29°C). The Guiana Current is the main current which is composed predominantly of the warm North Brazil Current which flows north along the north-eastern coast of South America. The North Brazil Current is characterised by large anti-cyclonic eddies that are formed between June and January. Upon reaching French Guiana this current separates from the coast and joins the North Equatorial Counter Current. The rest of the North Brazil Current continues flowing north-westward to form the Guiana Current (Condie, 1991). Between July and December the currents mainly flow from the southwest to the northeast quadrant (Artigas et al., 2003) and the highest current speeds are measured in April-May along the edge of the continental shelf (Gyory et al., 2005).

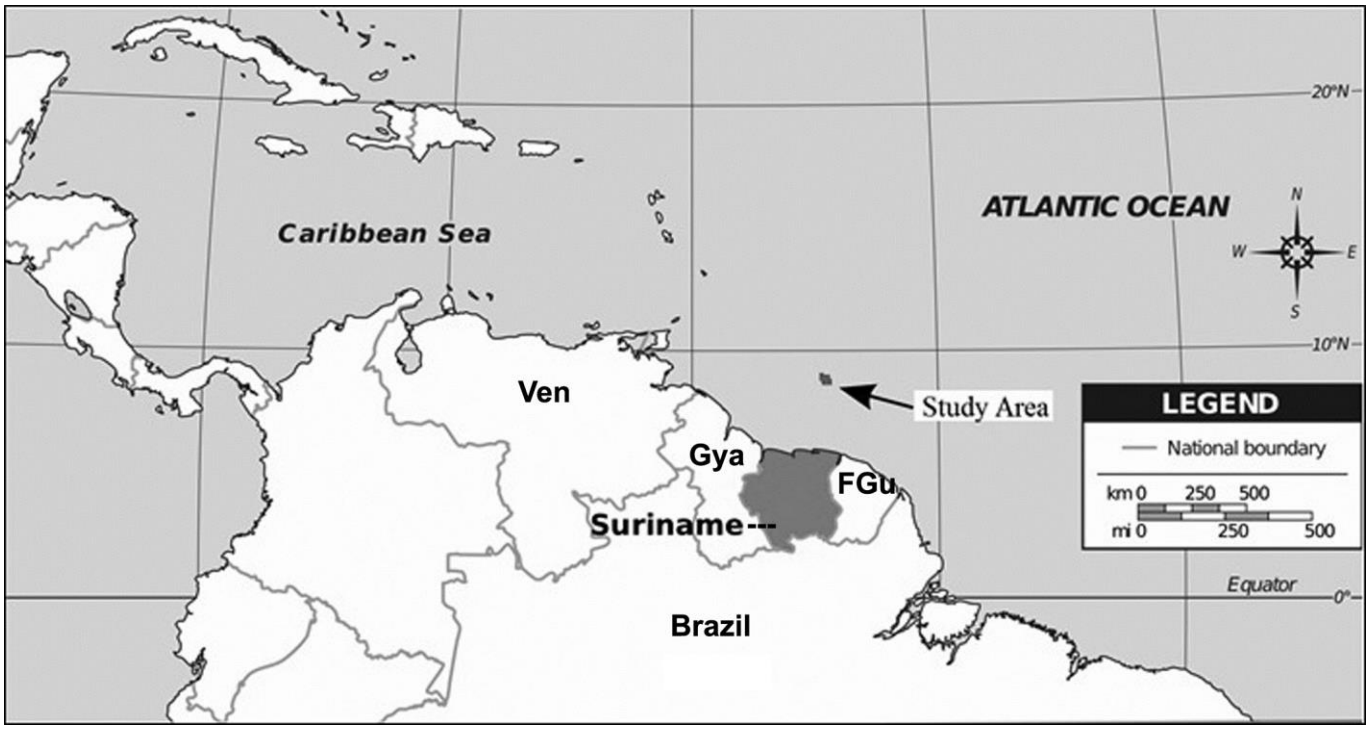

Figure 1. Location of the study area of Suriname and neighbouring countries Venezuela (Ven); Guyana (Gya) and French Guiana (FGu) and Brazil. The scale is presented in kilometres and nautical miles (mi).

Absence/Presence census

Between 17 May and 24 July 2012 a daily presence/absence log was kept for the seabird species observed in the study area. . The observers scanned the sea with the naked eye and with binoculars (Pentax & Review 8x43 & Opticron DBA Oasis 10x42). DSLR cameras with zoom lenses (Sony 700alpha with a 200mm f2.8 lens and a Canon EOS550D with a 100-400 f4.5-5.6 lens) were used to take photographs of seabirds when feasible. This allowed for subsequent identification checks of difficult and/or distant birds and provided reference material. Regular observation was also undertaken to check for species known to follow ships. All seabird identifications were confirmed by at least two observers or by photograph to alleviate any 'single observer' issues. Where available, cropped photographs of the species recorded are annexed to this publication allowing for an overview as some records are of significance to Suriname waters. Higher resolution digital files are also available upon request.

Strip-transect seabird survey

In addition to the daily presence/absence log, strip-transect seabird counts, which have been developed as a standard for ship-based seabird surveys in western Europe (Tasker et al., 1984; Camphuysen and Garthe, 2004.) were carried out for a period of 6 weeks (13 June to 24 July 2012). Counts were conducted from the bridge wings by one observer operating a 500m wide transect on one side

and ahead of the vessel. Most surveys were conducted while the research vessel was underway at an average speed of 4 knots and observers went 'off effort' when sea states exceeded Beaufort 4. Hand-held range finders were used to ground-truth the width of the 500m survey strip (Heinemann, 1981). Birds were normally detected with the naked eye and identified using binoculars. Standard observational periods of 10 minute duration were used for all strip-transect surveys. All birds, both on the water and flying were recorded continuously when in transect. In addition, all birds in flight occurring within the regular 'snapshot count' (every 4 minutes) were recorded separately. We estimated the density of birds (birds/km^2) according to Webb and Durinck (1992). Because the numbers of seabirds were relatively low, we also computed the relative abundance of seabirds using all birds recorded (flying and resting) within transect (birds/km). Simultaneously, a 180° scan of the area ahead of the vessel was used to record scarcer species, feeding frenzies and multi-species feeding associations.

The seabird surveys ran simultaneously with oceanographic observations. Water depth and surface temperature were measured throughout the survey period. Floating mats of brown macroalgae of the genus *Sargassum* (*Sargassum fluitans*) were a commonly seen feature in the deep waters and these often extended for several kilometers. Notes were made regarding the presence and size of these floating mats on a daily basis and when strip-transect seabird surveys were taking place. A Garmin GPS (GPSMAP76CSX) was used to log the ship's position every minute (Fig. 2). Only seabird records collected offshore in Suriname waters in the immediate study area (20 May – 24 July) are presented in this paper, unless stated otherwise.

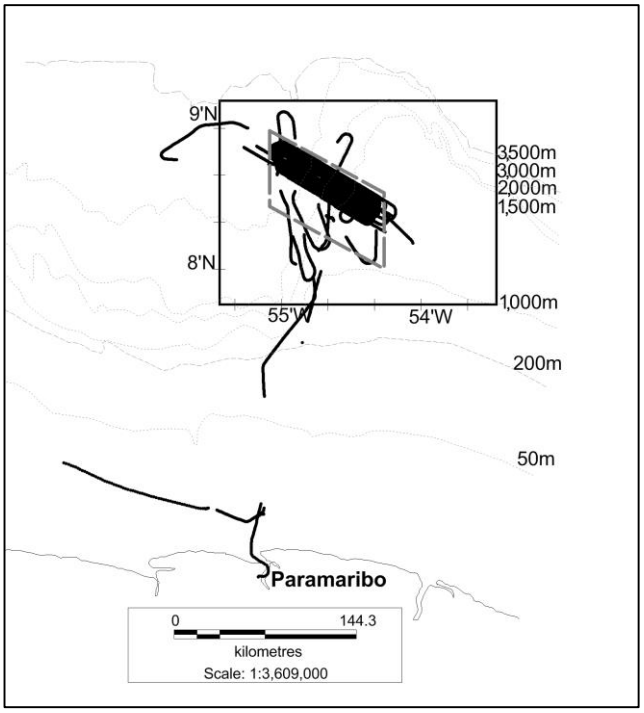

Figure 2. GPS tracks (in black) of the Western Regent surveyed between 17 May and 24 July 2012 together with information on water depth contours (in metres).

Results and Discussion

Overall, the number of seabirds encountered throughout the study area was low, although moderate diversity was noted with 18 species recorded (Table 1). Species identified but not verified by photographs included Buwler's Petrel (*Bulweria bulwerii*) and Wilson's Storm-Petrel (*Oceanites oceanicus*).

Strip-transect seabird survey

A total of 432 observation periods of 10 minutes were carried out totalling 72 hours. Forty-five transects were surveyed giving combined observational coverage of 512 km (Table 2). The water depth measured during these transects ranged from 1,239.5 to 3,126.0m (mean depth = 2,264.2m, n = 45, SD 613.9). The sea surface temperature (SST) remained fairly constant throughout the study period (mean SST = 28.45°C; range 26 - 30°C) as did the air temperature (mean 27.6°C, range 26 - 28°C).

Within visual range of the transect, a total of 301 seabirds was counted, representing at least seven species. Most seabirds were observed flying (84.4%) as opposed to resting (15.6%) and no 'ship-followers' were recorded (probably due to the overall low bird activity). Within transect, the density of resting birds on the water was 0.152 birds/km^2 and the density of flying birds seen during snapshot counts was 0.191 birds/km^2 (Table 2). Within transect, shearwaters were the most frequently encountered seabirds accounting for 90.1% (n = 190) of all birds recorded (data not shown). Within visual range this is slightly lower (78.1%, n = 235; Table 3). The majority of shearwaters recorded were Great Shearwaters (*Puffinus gravis)* although Cory's Shearwaters (*Calonectris diomedea)* and Audubon's Shearwaters were also frequently encountered. Great Shearwaters were the most numerous totaling 120 birds. The relative abundance was also the highest for Great Shearwaters (0.234 birds/km), closely followed by Cory's Shearwater (0.152 birds/km; Table 3). Less abundant were the smaller shearwaters (pooled data for Audubon's and Audubon's/Little Shearwater) with a relative abundance of 0.02 birds/km^2 (Table 3). Sooty Terns (*Onychoprion fuscatus)*, Pomarine Jaeger (*Stercorarius pomarinus)*, Red-billed Tropicbirds (*Phaethon aethereus)* and Leach's Storm-Petrels *(Oceanodroma leucorhoa)* were less abundant (Table 3).

The relative abundance of Cory's Shearwaters was highest from 13 to 15 June 2012. They became less abundant for the remainder of the study (except for 30 June when several aggregations of Cory's were encountered). With the abundance of Cory's Shearwater falling, the abundance of the Great Shearwater started to increase steadily until a peak in abundance was observed on 17 June (Fig. 3). From that date onwards the density of Great Shearwater steadily decreased until 9 July. These two large shearwater species were only occasionally observed after that time (Fig. 3).

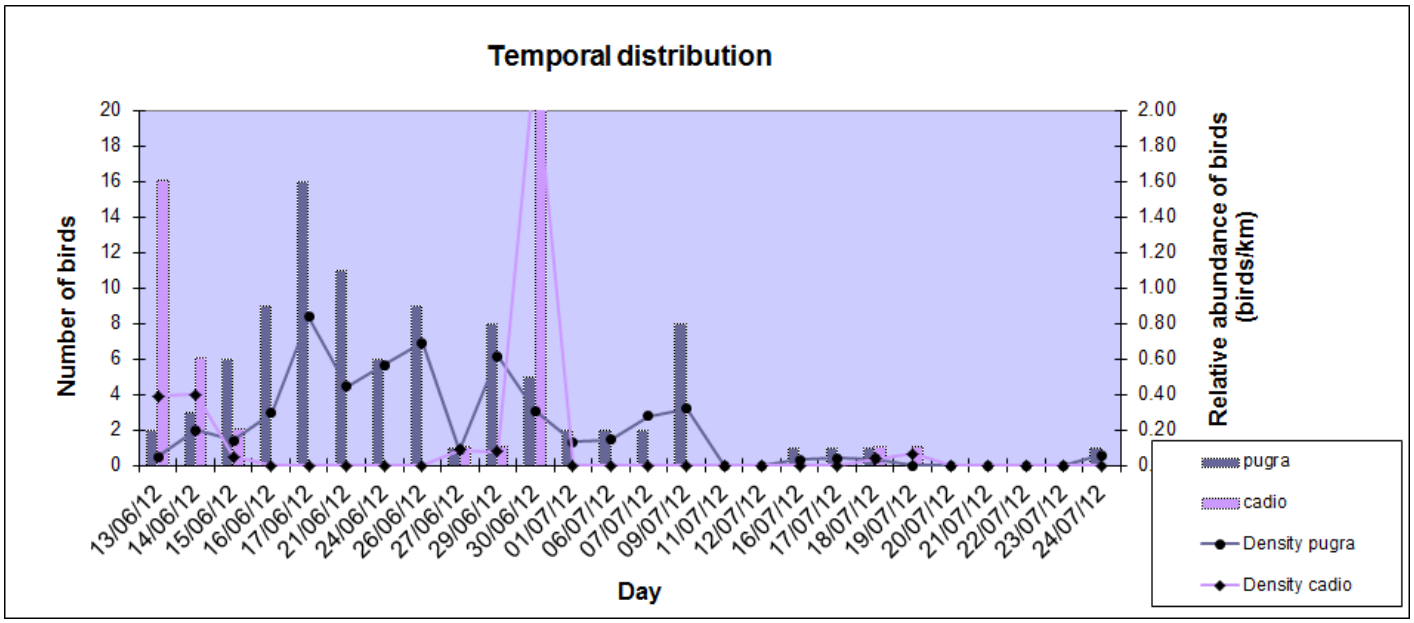

Figure 3. The number of Great Shearwater (pugra) and Cory's Shearwater (cadio) seen during strip-transect survey for each survey day together with the relative abundance – the number of birds per km.

Table 1. An overview of the total number of days (*n* = 69) during which different seabird species were recorded during the absence/presence seabird census, including the three days of transit in shallow waters between 17 May and 19 May 2012

Common name	Scientific name	Number of days	% total days
Great Shearwater	*Puffinus gravis*	50	72.5
Cory's Shearwater	*Calonectris diomedea*	31	44.9
Audubon's Shearwater	*Puffinus lherminieri*	21	30.4
Little/Audubon's Shearwater		20	29.0
Small shearwaters (Audubon's + Audubon's/Little Shearwater)		37	53.6
Petrel spec.		5	7.3
Bulwer's Petrel	*Bulweria bulwerii*	1	1.5
Wilson's Storm-Petrel	*Oceanites oceanicus*	4	5.8
Leach's Storm-Petrel	*Oceanodroma leucorhoa*	10	14.5
Band-rumped Storm-Petrel	*Oceanodroma castro*	1	1.5
Storm-petrel spec.		14	20.3
Red-billed Tropicbird	*Phaethon aethereus*	17	24.6
Magnificent Frigatebird	*Fregata magnificens*	4	5.8
Masked Booby	*Sula dactylatra*	1	1.5
Brown Booby	*Sula leucogaster*	2	2.9
Red-footed Booby	*Sula sula*	1	1.5
Jaeger spec.		24	34.8
Pomarine Jaeger	*Stercorarius pomarinus*	28	40.6
Laughing Gull	*Leucophaeus atricilla*	2	2.9
Tern spec.		6	8.7
Sooty Tern	*Onychoprion fuscatus*	41	59.4
Royal Tern	*Thalasseus maximus*	1	1.5
Common Tern	*Sterna hirundo*	1	1.5
Yellow-nosed Albatross	*Thalassarche chlororhynchos*	1	1.5
Dead shearwaters		9	13.0
Feeding frenzy (shearwaters & Sooty Terns)		16	23.2

Table 2. Density (N/km^2) of flying birds seen during snapshot counts, of resting birds seen within the transects and the relative abundance (N/km) of all seabirds within visual range (total distance: 512km, number of transects: 45, area covered by transect strips: 256km^2, 10-minute observation periods: 432).

Strip-transect seabird survey - Parameter	***N (number of birds)***	***Value***
Density of flying birds	49	0.191 birds/km^2
Density of resting birds	39	0.152 birds/km^2
Relative abundance of all seabirds	301	0.588 birds/km

Foraging behaviour

Between mid-June and mid-July, multi-species foraging associations were occasionally recorded. Species actively involved in such aggregations included shearwaters (all three species) accompanied by Sooty Terns and the occasional Pomarine Jaeger. The foraging behaviour of Great and Cory's Shearwaters recorded during these aggregations included shallow dives, plunge-diving, actively searching for prey by peering under water and chasing flying fish. The Audubon's Shearwater foraging behaviour noted during this study included plunge-diving. Kleptoparasitism was evident on occasion with (dark morph) Pomarine Jaeger chasing Audubon's Shearwater and also pursuing Cory's Shearwaters. Shearwaters were associating with feeding schools of Skipjack Tuna (*Katsuwonus pelami)* and other unidentified tuna species and also occasionally Dolphinfish (*Coryphaena hippurus*) and Yellowfin Tuna (*Thunnus albacares*). Both Cory's and Great Shearwaters were observed in catching prey, involving small fish and flying fish sp.

Associations with algae and debris

The presence of floating mats of the genus *Sargassum* (*Sargassum fluitans*) was recorded within visual range during the strip-transect study. All three shearwater species were observed loosely associating with these algae mats. During the strip-transect survey 9.2% of all Great Shearwaters and 11.5% of all Cory's Shearwaters were seen in areas with floating *Sargassum* algae, whilst only one Audubon's Shearwater (4.6%) was recorded as such. Other species observed diving/swimming along the edges of *Sargassum* mats included Common Tern (*Sterna hirundo),* Sooty Tern and Red-billed Tropicbird. Leach's Storm-Petrels were more typically seen along fronts or slicks. Very small amounts of plastic debris were observed in the present study, and no associations between seabirds and plastics were recorded.

Table 3. Relative abundance (total number of birds within visual range per km effort) of species and species groups recorded during the 512km strip-transect survey.

Common name	**Total number *within visual range***	**Relative abundance *birds/km***
Great Shearwater	120	0.234
Cory's Shearwater	78	0.152
Audubon's Shearwater	12	0.023
Audubon's/Little Shearwater	10	0.020
Great/Cory's Shearwater	15	0.029
Leach's Storm-Petrel	3	0.006
Sooty Tern	45	0.088
Tern spec.	4	0.008
Red-billed Tropicbird	5	0.010
Pomarine Jaeger	8	0.016
Jaeger spec.	1	0.002
All small shearwaters	22	0.043
All large shearwaters	213	0.416
All shearwaters	235	0.459
All Jaegers (Pomarine+jaeger spec.)	9	0.018
All terns (Sooty+tern spec.)	49	0.096
All seabirds	301	0.588

Absence/Presence census

Species diversity was highest from early June to mid-July ($\bar{x}$ = 4.5 species seen per day; range 2-7). Shearwaters were recorded throughout the survey period, with an increase in abundance noted towards the end of May (Appendix 1). Great Shearwaters were recorded on 50 days (72.5% of total survey days), closely followed by Cory's Shearwater (n = 31 days, 44.9%) and Audubon's Shearwater (n = 21, 30.4%; Table 1).

Records of feeding frenzies peaked between 19 June and 12 July.

Species Accounts

The following species accounts highlight the most pertinent observations from this baseline study and also provide a summary of the current documented status within a Suriname context.

Cory's Shearwater (Calonectris diomedea)

Cory's Shearwater (Plate 1) became less numerous from mid-July onwards (with only five records between 15 and 24 July 2012; Appendix 1). Cory's Shearwaters observed in the present study were all within the 1,500-3,000m depth contours and at times were seen foraging alongside *Sargassum* algae (Fig. 4; Plate 1G). The present status of Cory's Shearwater is uncertain for Suriname (IUCN, 2013) and the species is considered a rare bird. Three sightings of Cory's Shearwater have thus far been recorded in Suriname during the northern winter period (January, April; Ottema et al., 2009). The species is also known from the neighbouring countries of Guyana and French Guiana (IUCN, 2013).

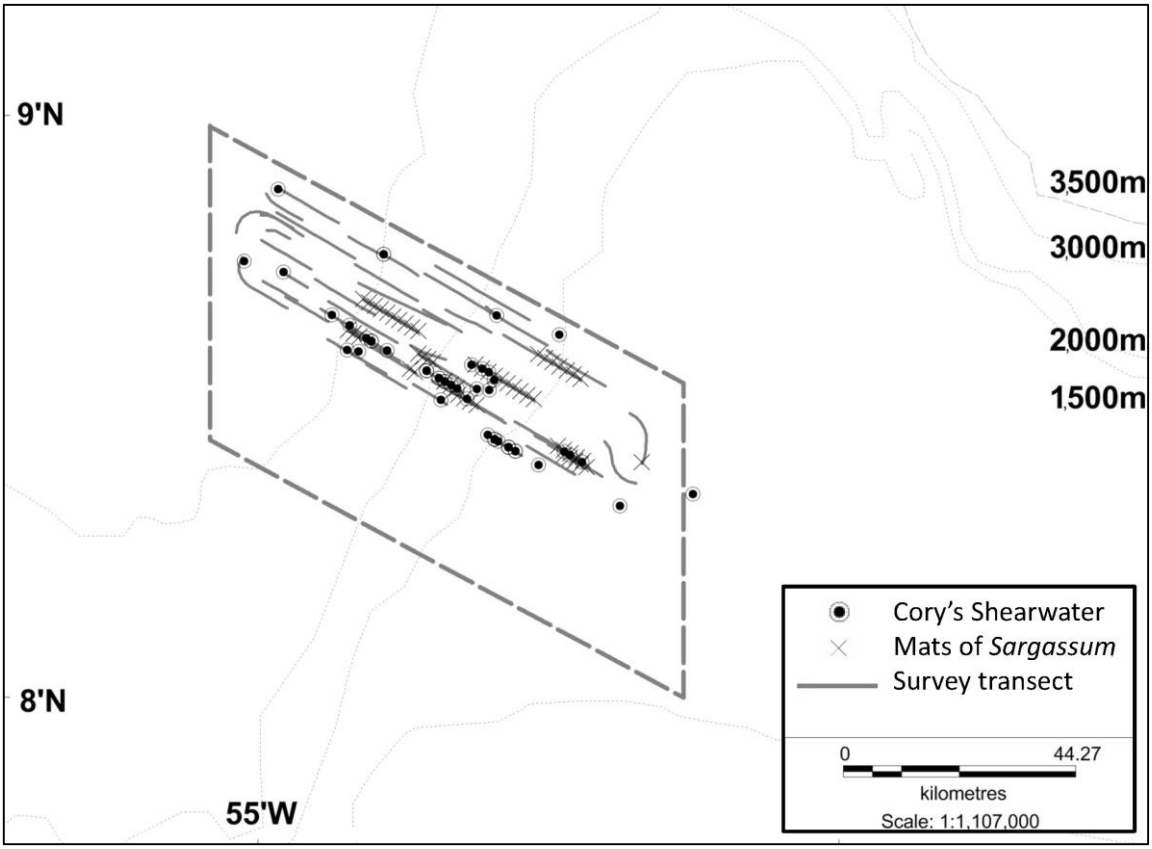

Figure 4. Position of survey transects, Cory's Shearwater sightings (including off-effort sightings) and floating mats of *Sargassum* algae. Information on water depth contours (in metres) is also shown.

Great Shearwater (*Puffinus gravis)*

Great Shearwaters (Plate 1) were first recorded on 3 June 2012; from this date they were regularly recorded throughout the survey period. A mortality of shearwaters was recorded during the period 28 June to 7 July during which at least 20 dead birds were counted (Fig. 5) with a relative abundance of 0.0078 dead birds/km (based on strip-transect counts; n = 4). Only two records are known for Suriname (Ottema et al., 2009) of which one record relates to a mass-mortality of Great Shearwaters in mid-June 1974. These shearwaters had died from starvation and washed ashore east of the Suriname River, Commewijne and Marowijne Districts, with some 150 birds counted between the mouth of the Matapicakanaal and the mouth of the Oranjekreek (over 35 km; Mees, 1976). Great Shearwaters have been recorded from mid-April through late December off the SE coast of the US (Clapp et al., 1982; Lee 1986, 1995) which is consistent with our observations. The Great Shearwater undertakes a trans-equatorial migration, departing from their breeding grounds in the south Atlantic with birds moving northward in April and May, then moving north-west to South America, up to Canada, past Greenland and onto the north-east Atlantic before returning south in November to their breeding colonies (Harrison, 1983; Carboneras, 1992a).

Mass die-offs, such as the one recorded in Suriname (Mees, 1976), have also been documented elsewhere in the

southern Caribbean (Trinidad; Collins & Tikasingh, 1974) and off the southeastern US (Lee, 2009). These die-off events are restricted to late spring and early summer and often consist of between hundreds to thousands of dead and dying 'non-breeding' birds (Lee, 2009). The weights of the stranded birds found in the US and off Suriname (in 1974) are consistent with birds that have died of starvation and indicate that the mortality is linked to stress related to the northward migration (Lee, 2009). Watson (1970) first proposed that the cause of these events is the result of the difficulty of migrants crossing the doldrums in certain years. These windless conditions deplete energy reserves as the combination of limited food resources, extra energy demands needed for flight, and increased time needed to travel through the area take their toll on the shearwaters. These seasonal mass die-offs suggest that for this species low recruitment rates are the result of timing of migration as it relates to equatorial weather patterns that in turn are potentially influenced by global warming (Lee, 2009). In the present study, carcasses were recorded as Great/Cory's Shearwater. Some of the freshly dead birds were identified as Great Shearwaters when plumage characteristics were visible (Plate 1F). None of the dead birds could be retrieved and the cause of this mortality is therefore unknown. However, the recorded shearwater mortality in the present study was notable shortly after a long-line fishing vessel was seen in the general area. A direct link between the dead birds and the fishing vessel could not be ascertained but these birds could have been killed by long-line fishing practice (we photographed a few flying Great Shearwater trailing a fishing line; Plate 1E). The NOAA Fisheries National Seabird Program identified Great Shearwaters to be the species most commonly encountered as by-catch in Atlantic pelagic long line fishery (Hata, 2006). Our observations are of importance as it is usually impossible to pin-point the location where mortality occurs.

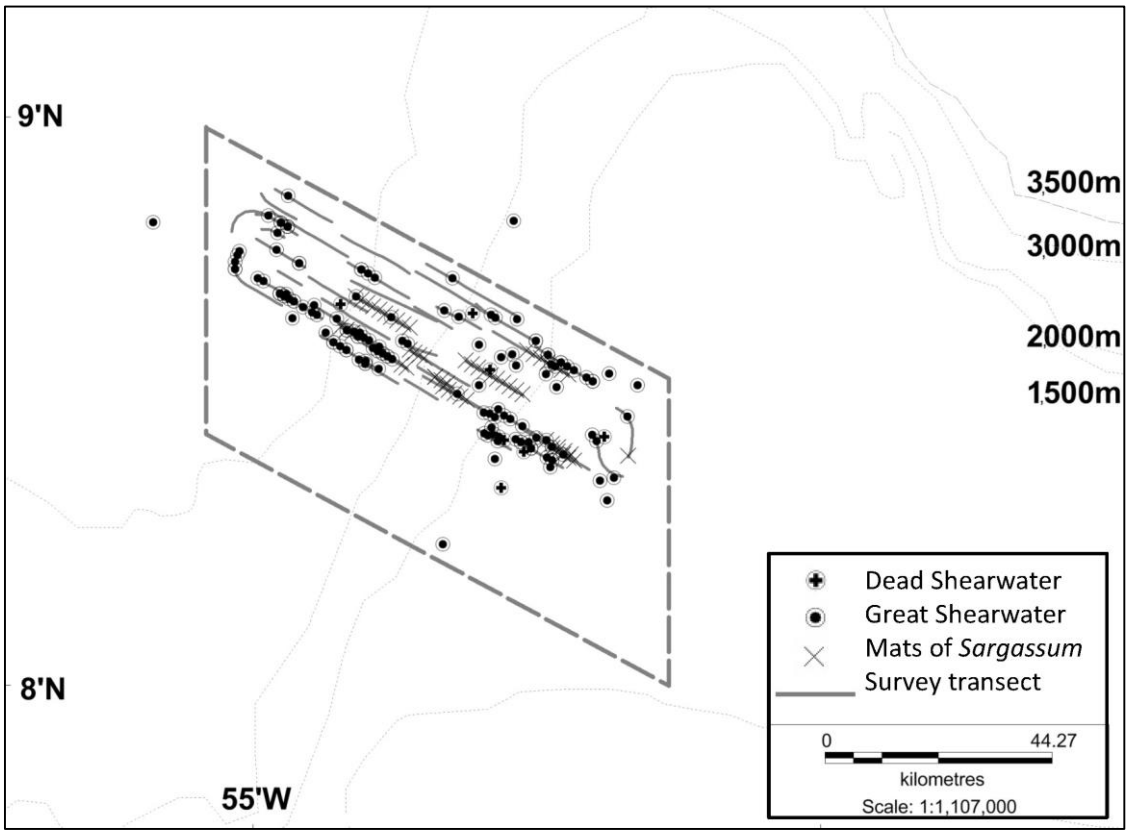

Figure 5. Position of survey transects, Great Shearwater (including off-effort sightings) and dead shearwater sightings and floating mats of *Sargassum* algae. Information on water depth contours (in metres) is also shown.

Audubon's Shearwater (*Puffinus lherminieri)*

Sightings of Audubon's/Little Shearwater were recorded throughout the survey period and records of Audubon's Shearwater peaked with 11 confirmed records between 6 to 20 July 2012. The Audubon's Shearwater (Plate 2) is considered a rare bird for Suriname, and only one sighting has been previously recorded on 12 January 1971 about 190 nm off the coast, north of Paramaribo (Ottema et al., 2009). The small shearwaters in our study area were most likely to be Audubon's Shearwaters as it is unusual to find Little Shearwaters in this region (although vagrants have been recorded in French Guiana; IUCN 2013). The Audubon's Shearwater is the only shearwater species that breeds in the Caribbean Region and during a boreal winter survey a few birds were recorded off Venezuela and in the south eastern Caribbean region (Murphy, 2000). The species is also known from Guyana and French Guiana (albeit its occurrence in the latter needs verification; Ottema et al., 2009). The Audubon's Shearwater was recorded throughout the survey area and generally over deep waters (Fig. 6). Assuming that all birds recorded in the present study as small shearwaters (Audubon's/Little Shearwater) were Audubon's Shearwaters, then this would make the species commonly recorded in this region (n = 37; 53.6%; Table 1). The

present study provides the first photographic records for Suriname (Plate 2).

Figure 6. Position of survey transects, Audubon's Shearwater sightings (including off-effort sightings) and floating mats of *Sargassum* algae. Information on water depth contours (in metres) is also shown.

Wilson's Storm-Petrel (*Oceanites oceanicus)*

The Wilson's Storm-Petrel was positively identified on four occasions during the census study in late May and early June 2012 (dates: 23, 28 May and 5, 10 June) and was less frequently observed than the Leach's Storm-Petrel. No photographs were forthcoming and the Wilson's Storm-Petrel was recorded once during the strip-transect survey in relatively shallower waters (<1,500m; Fig. 7). The species is considered rare for Suriname but has been recorded in July (1960) on a trawler and in November (1972) one specimen washed up dead near the mouth of the Matapicakanaal, Commewijne District (Ottema et al., 2009). This species has been recorded during a boreal winter survey off Trinidad and Tobago (Murphy 2000) and also off Venezuela and the neighbouring countries of French Guiana and Guyana (IUCN, 2013).

Leach's Storm-Petrel (*Oceanodroma leucorhoa)*

The Leach's Storm-Petrel was recorded only occasionally during June, but was recorded on 7 days from 9 to 22 July 2012 (Fig. 7; Plate 2). Records of this species were also recently made in July and August 2013 off Suriname (De Boer, pers. obs.). Leach's Storm-Petrels are regularly recorded in Suriname and the species is known to occur from January through July, with highest numbers from March through May (Ottema et al., 2009). This species was also most common during a boreal winter survey in the Columbus Channel between Trinidad and Venezuela (Murphy, 2000) and is known to occur off French Guiana and Guyana (IUCN, 2013).

Band-rumped Storm-Petrel (*Oceanodroma castro*)

On 20 July 2012, a Band-rumped Storm-Petrel was recorded (as an incidental observation) by its characteristic flight pattern (e.g. Flood and Fisher, 2011) and confirmed through photographs (Plate 2). Recent published research on the Band-rumped Storm-Petrel complex indicates that it includes numerous taxa, perhaps as many as ten worldwide and the migration patterns are not clear since identification at sea is difficult (Howell et al., 2010). The present observation is a new state record for Suriname.

Bulwer's Petrel (*Bulweria bulwerii)*

One record was made of this species on 17 May 2012 close to the coast but was not verified by photograph. This species has been recorded off French Guiana but not off Guyana or Suriname (IUCN, 2013).

Red-billed Tropicbird (*Phaethon aethereus)*

The Red-billed Tropicbird was occasionally seen throughout the whole study area with a calculated density of 0.02 birds/km^2 (Fig. 7). The species was recorded mostly in June, most notably with records occurring on 13 days between 9 June and 3 July 2012. The Red-billed Tropicbird is regarded as a rare species in Suriname. Only one genuine sighting has been previously recorded in

Suriname (31 July 1982), when an immature bird was seen passing over inshore waters at the mouth of the Matapicakanaal, Commewijne district but was not proven by photograph (Ottema et al., 2009). This species breeds off Trinidad and Tobago (Bradley and Norton 2009) and occurs off Venezuela (IUCN, 2013) and has also been recorded off Guyana (Ottema et al., 2009). The Red-billed Tropicbirds in the present study were seen associating with floating mats of *Sargassum* algae and observed plunge-diving in particularly seeking out areas where currents were concentrating these floating mats, presumably because here the fish concentrations are greater. Most birds photographed were adults with fully developed tail streamers (Plate 3) although one immature bird was noted. The present study provides the first photographic records for Suriname.

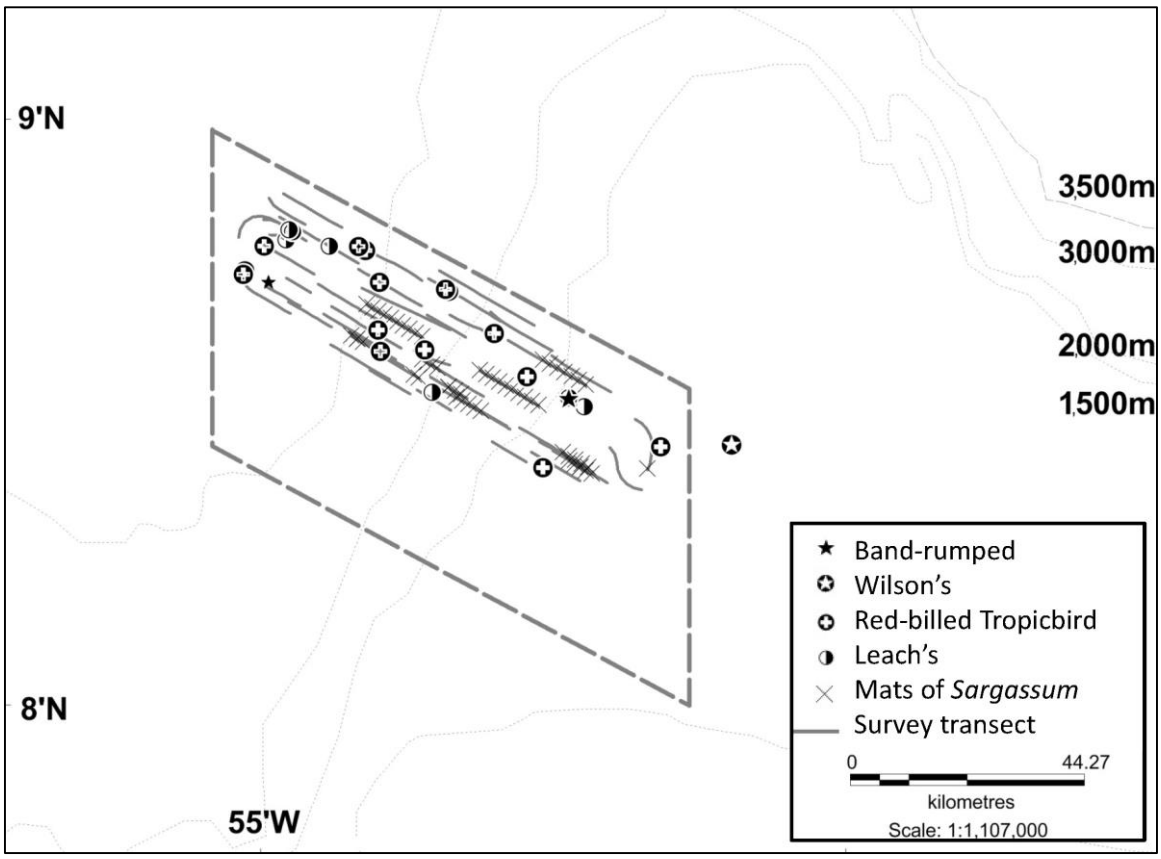

Figure 7. Position of survey transects, Leach's Storm-Petrel, Wilson's Storm-Petrel, Band-rumped Storm-Petrel and Red-billed Tropicbird sightings (including off-effort sightings) and floating mats of *Sargassum* algae. Information on water depth contours (in metres) is also shown.

Yellow-nosed Albatross (*Thalassarche chlororhynchos)*

On 10 June 2012, a Yellow-nosed Albatross was observed by JTS over the eastern part of the study area (Fig. 8) and was seen briefly following the vessel at dusk. The photos taken at the time confirmed the identification; however they are not shown due to their low resolution/poor quality. It is most likely that the specimen was an Atlantic Yellow-nosed Albatross (*T. c. chlororhynchos*) rather than the Indian Yellow-nosed Albatross (*T. c. carteri*). The former has been recorded off Brazil (IUCN, 2013) and has been recorded off French Guiana (Restall et al., 2006). However, the photographs taken during the present survey do not reveal enough details to distinguish between the two (Ribot 2013). Recently, an immature Yellow-nosed Albatross was photographed off French Guiana on 17 June 2011 (Johan Chevalier, pers. com.; Plate 3). The only other record for an albatross species in Suriname is from 15 May 1968, and potentially involves a Wandering Albatross (*Diomedea exulans)* that was observed off the coast, roughly 90 nm north of Paramaribo (Ottema et al., 2009). On 29 May 1968, another albatross was sighted off the coast, roughly 80 nm north of WiaWia, Marowijne District (Ottema et al., 2009). Albatrosses are considered rare in the North Atlantic (IUCN, 2013) and the present observation is a new state record for Suriname.

Red-footed Booby (*Sula sula)*

The observation of an immature white-morph Red-footed Booby on 7 June 2012 on the eastern part of the study area (Fig. 8; Plate 3) confirms the species' occurrence in Suriname offshore waters and as such presents a new state record. An immature Red-footed Booby was also recently recorded in August 2013 off Suriname (De Boer, pers. obs.). Ottema et al. (2009) categorised this species as 'hypothetical' for Suriname since Red-footed Boobies are widely distributed over the southwestern Atlantic Ocean. The Guianas are sometimes included within the distribution area of the species (Carboneras 1992b; Rodriguez Mata et al., 2006), however it has not been recorded in Suriname (IUCN, 2013). Murphy (2000) recorded good numbers of this species off

Venezuela and furthermore noted that the white morph of the Red-footed Booby was dominant from Isla Margarita westward whereas the brown morph was dominant farther east.

Masked Booby (*Sula dactylatra)*

An adult Masked Booby was photographed on 11 July 2012 over the deeper part of the study area (>3,000m; Fig. 8). Masked Boobies were also recently recorded in August and September 2013 off Suriname (De Boer, pers. obs). The species is regarded as a vagrant as only two sightings are known for Suriname (in April 1969, and in late August/early September 1970; Ottema et al., 2009). The species is not known to occur in Guyana and French Guiana (IUCN, 2013). Murphy (2000) noted that Masked Boobies were more common in the western Caribbean and were scarce from Isla Margarita in Venezuela eastward. The present study provides the first photographic records for Suriname (Plate 3).

Brown Booby (*Sula leucogaster)*

An adult Brown Booby was observed on 21 May 2012 and a second sighting was made on 17 July (Fig. 8). Immature Brown Boobies were also recently recorded in August and September 2013 off Suriname (De Boer, pers. obs.). The Brown Booby is a rare non-breeding visitor for Suriname waters and usually single birds are occasionally seen at sea from the mouth of the big rivers to beyond the Continental Shelf (Ottema et al., 2009). No records for Suriname exist for April-May, July-September and November-December and all birds previously recorded were immature (Ottema et al., 2009). High counts of Brown Boobies were recorded during a winter pelagic survey off Venezuela (Murphy, 2000). The species also occurs off French Guiana and Guyana (IUCN, 2013).

Magnificent Frigatebird (*Fregata magnificens)*

Several sightings of Magnificent Frigatebirds were made in the study area: on 29 May, 22 June and 13 July 2012. In addition, the species was recorded on 17 May whilst in shallow waters during transit to the study area. The species breeds in French Guiana but not in Suriname (Ottema et al., 2009). This species, a typical coastal species, was not recorded offshore during a recent boreal winter seabird survey and was most commonly seen near Curaçao, Bonaire, Isla Margarita, and Trinidad and Tobago (Murphy, 2000). Those Magnificent Frigatebirds recorded in the present study were noted over the shallower end of the study area (<1,500m; Fig. 8).

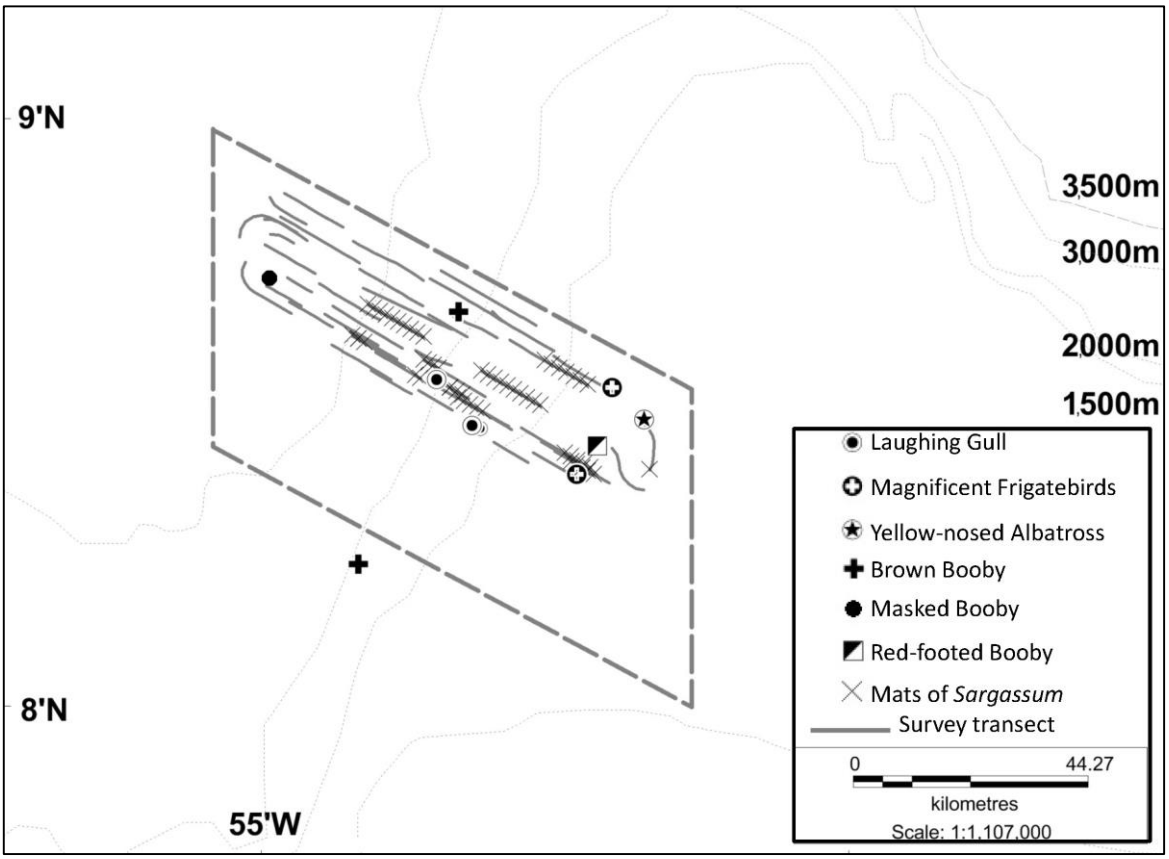

Figure 8. Position of survey transects, Laughing Gull, Magnificent Frigatebird, Yellow-nosed Albatross and various Booby species and floating mats of *Sargassum* algae. Information on water depth contours (in metres) is also shown.

Pomarine Jaeger (*Stercorarius pomarinus)*

The Pomarine Jaeger was frequently recorded during the 2012 survey but peaked between 27 June and the end of the survey (on 24 July) and were distributed throughout the study area (Fig. 9). All records were of birds in non-breeding plumage with both light and dark morph individuals noted (Plate 2). Only a few sightings currently exist for Suriname (12 January 1971, 3 January 1982, 1 November 2004; Ottema et al., 2009). Although, the previous sightings for Suriname are genuine they were not accompanied by photographs. The records we present here confirm the presence in offshore waters between May-July

and in addition provide the first photographic records for Suriname.

Jaegers were often difficult to ascribe to species level with any degree of confidence. Other jaegers previously recorded in Suriname include the Parasitic Jaeger (*Stercorarius parasiticus;* Ottema et al., 2009). This species is also known from Guyana and French Guiana (IUCN, 2013) and Venezuela (Murphy, 2000). The South Polar Skua (*Catharacta maccormicki)* migrates via Suriname offshore waters (Kopp et al., 2011) and there are credible records of this species from the region (e.g. Venezuela, references in Murphy, 2000). The Brown Skua *(Stercorarius antarcticus)* has also been recorded within Suriname waters. This species was found stranded on 5 May 1976, northeast of Bigi Pan, Nickerie District and a possible record of a Brown Skua was made in June 2013 by MDB (Ribot, 2013). There are no published or unpublished records of Great Skua (*Stercorarius skua)* for Suriname but this species is considered as a hypothetical visitor due to its migrations (Ottema et al., 2009).

Laughing Gull (*Leucophaeus atricilla)*

On 28 June 2012, an adult Laughing Gull was seen briefly resting on the vessels' helideck (Fig. 8). This species was again seen on 23 July. Laughing Gulls are known to be present in Suriname as non-breeding birds (Ottema et al., 2009).

Terns - Common Tern (*Sterna hirundo),* Royal Tern *(Thalasseus maximus)* & Sooty Tern (*Onychoprion fuscatus)*

A Common Tern was photographed on 20 May 2012 (Fig. 9). The Tern was seen foraging alongside a large mat of floating *Sargassum* algae and afterwards tried landing on the ship's mast. This species is known to be present in Suriname throughout the year, but with lower numbers during December and January (Ottema et al., 2009). An adult Royal Tern was photographed on 12 June 2012 in the eastern part of the study area (Fig. 9). The Royal Tern is known to occur in Suriname as a non-breeding bird (Ottema et al., 2009). The Sooty Tern was recorded frequently (n = 41, 59%; Table 1) and was distributed throughout the study area but rarely over waters > 3,000m depth (Fig. 9). This species was often seen in flocks flying high above the ocean surface (100+m) during foraging sorties. Frenzied feeding activities over aggregations of bait fish were also regularly observed. This species was often observed within multi-species foraging associations-usually with shearwaters and also with attendant jaegers. This tern is known to be present in Suriname and when at sea appears to be confined to the edge of the Continental Shelf and beyond, where it is often encountered in flocks of over 50 birds (Ottema et al., 2009).

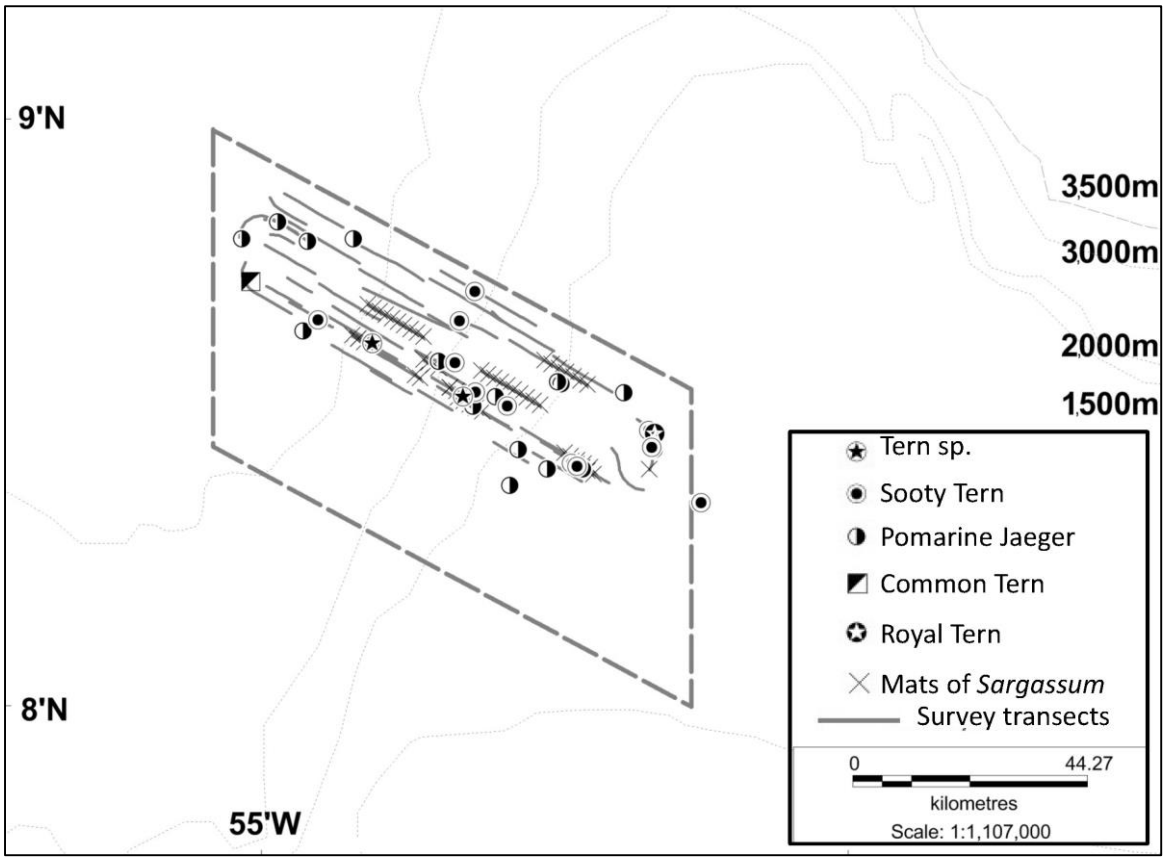

Figure 9. Position of survey transects, Pomarine Jaeger, Sooty Tern, Common Tern, Royal Tern, tern sp. (including off-effort sightings) and floating mats of *Sargassum* algae. Information on water depth contours (in metres) is also shown.

Terrestrial bird species – From mid-July onwards, occasionally waders were seen on their southbound migration. Species noted included Willets (*Tringa semipalmata*), Spotted Sandpipers (*Actitis macularius*) and

Lesser Yellowlegs (*Tringa flavipes*). A Common Swift (*Apus apus*) was also observed in the study area, 150nm from the coast and this is a new record for Suriname and South America (De Boer et al., in press).

Conclusions

The Suriname offshore region is not well described and it is therefore difficult to fully appreciate the importance of this region for seabirds. The seabird density in the study area was relatively low as is the case in tropical offshore equatorial regions which are dominated by low productivity, little seasonality and low seabird diversity (e.g. Cherel et al., 2008). The seabird community in the present study was predominated by shearwater species comprising 78.1%. Species considered being primarily surface feeders and plunge divers such as storm-petrels, jaegers, terns, and tropicbirds comprised 21.9% and these were unlikely to reach depths of more than 2m below the surface. However, shearwaters were seen to be only shallow-diving, in aerial pursuit of flying fish and plunge-diving in foraging concentrations but no deep-diving was observed.

Based on these observations, we describe the offshore seabird community in Suriname as primarily a surface-feeding community. Seabirds commonly associate with feeding schools of Skipjack Tuna, Yellowfin Tuna and Dolphinfish that force prey to the surface (Clua and Grosvalet, 2001; Jaquemet et al., 2004) and similar foraging aggregations were observed in the present study. On occasion, seabirds were observed foraging along oceanic features that dominated the study area.

Whilst we acknowledge the limitations of small data sets, a distinct increase in both the density and diversity of seabirds from early June to mid-July was apparent. It is recommended that further monitoring be carried out in order to gain a better understanding of the status of the different species that occur in this tropical equatorial offshore region.

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Plate 1 – Large shearwaters. Cory's Shearwater (A, B); Great Shearwater (C-E), floating carcass (F); Cory's Shearwater associating with mats of *Sargassum* algae (G) and Great Sheawaters searching underwater (H). Photography © A.C. Williams (A); M.N. de Boer (B, D-H) and J.T. Saulino (C).

Plate 2 – Leach's Storm-Petrel (A, B); Band-rumped Storm-Petrel (C, D); Audubon's Shearwater (E, F) & Pomarine Jaeger (G, H). Photography © A.C. Williams (photo A-E, G); M.N. de Boer (F, H).

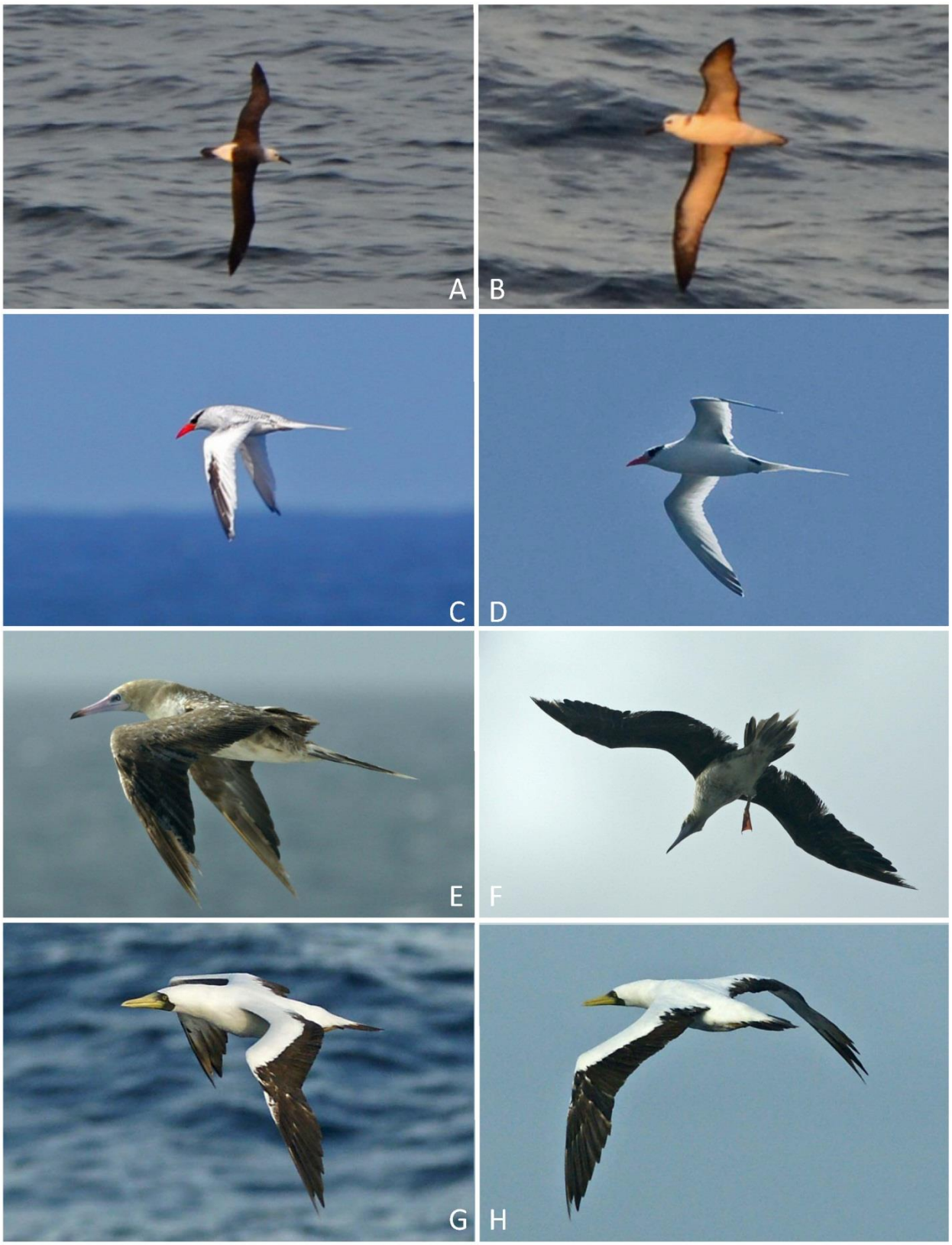

Plate 3 – Yellow-nosed Albatross off French Guiana (A-B), Red-billed Tropicbird (C-D); **Red-footed Booby** (E-F) & **Masked Booby** (G-H). Photography © J. Chevalier (A-B); A.C. Williams (C); M.N. de Boer (D, G-H) and J.T. Saulino (E-F).

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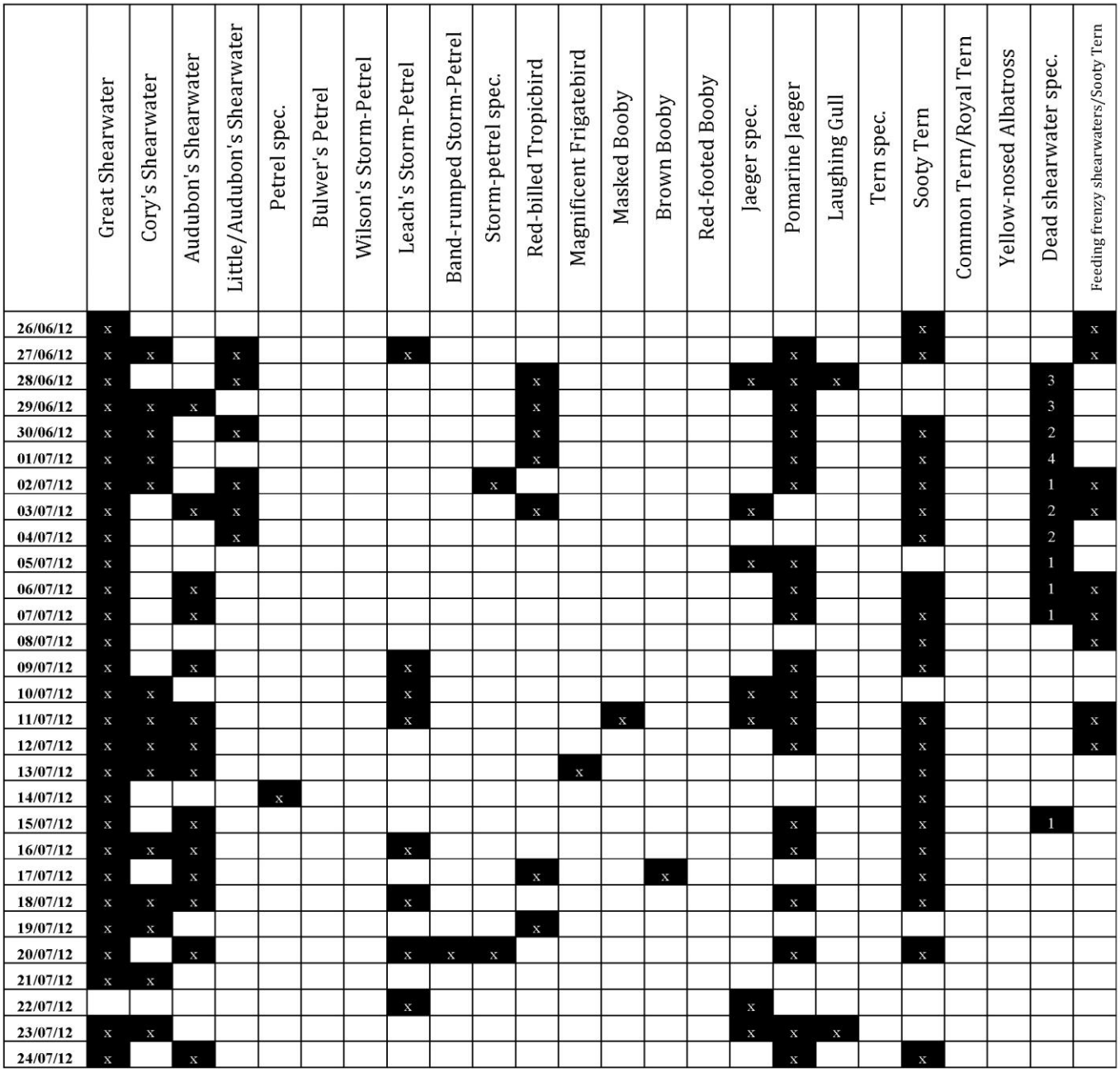
Appendix 1. Presence/Absence census of seabirds documented in Surinam waters (deep pelagic waters from 20 May). Together with presence of foraging hotspots recorded from 11 July onwards including dead shearwater species and feeding frenzies.

	Great Shearwater	Cory's Shearwater	Audubon's Shearwater	Little/Audubon's Shearwater	Petrel spec.	Bulwer's Petrel	Wilson's Storm-Petrel	Leach's Storm-Petrel	Band-rumped Storm-Petrel	Storm-petrel spec.	Red-billed Tropicbird	Magnificent Frigatebird	Masked Booby	Brown Booby	Red-footed Booby	Jaeger spec.	Pomarine Jaeger	Laughing Gull	Tern spec.	Sooty Tern	Common Tern/Royal Tern	Yellow-nosed Albatross	Dead shearwater spec.	Feeding frenzy shearwaters/Sooty Tern
17/05/12					x	x				x		x							x					
18/05/12																			x					
19/05/12					x														x					
20/05/12										x										x	C			
21/05/12				x	x			x						x										
22/05/12		x			x					x							x		x	x				
23/05/12							x																	
24/05/12				x						x									x					
25/05/12											x					x								
26/05/12																								
27/05/12																x				x				
28/05/12				x			xx									x	x			x				
29/05/12		x								x		x				x	x			x				
30/05/12				x																x				
31/05/12		x								x														
01/06/12																x								
02/06/12		x								x						x				x				
03/06/12	x	x															x			x				
04/06/12	x		x							x						x				x				
05/06/12	x						x			x	x													
06/06/12	x		x																	x				
07/06/12	x	x		x											x	x								
08/06/12	x	x	x	x	x			x		x						x	x		x	x				
09/06/12		x									x					x				x				
10/06/12	x	x					x				x					x				x		x		
11/06/12	x	x	x							x						x				x				x
12/06/12	x	x		x																x	R			
13/06/12	x	x															x			x				
14/06/12	x	x		x							x						x			x				
15/06/12	x	x									x									x				
16/06/12	x	x																						
17/06/12	x	x	x																	x				
18/06/12	x			x																x				
19/06/12	x			x							x					x				x				x
20/06/12	x	x		x												x				x				x
21/06/12	x		x	x						x	x					x				x				x
22/06/12	x		x	x								x				x	x			x				x
23/06/12	x			x							xx					x				x				x
24/06/12	x										x													x
25/06/12	x																x							



	Great Shearwater	Cory's Shearwater	Audubon's Shearwater	Little/Audubon's Shearwater	Petrel spec.	Bulwer's Petrel	Wilson's Storm-Petrel	Leach's Storm-Petrel	Band-rumped Storm-Petrel	Storm-petrel spec.	Red-billed Tropicbird	Magnificent Frigatebird	Masked Booby	Brown Booby	Red-footed Booby	Jaeger spec.	Pomarine Jaeger	Laughing Gull	Tern spec.	Sooty Tern	Common Tern/Royal Tern	Yellow-nosed Albatross	Dead shearwater spec.	Feeding frenzy shearwaters/Sooty Tern
26/06/12	x																			x				x
27/06/12	x	x		x				x									x			x				x
28/06/12	x			x							x					x	x	x					3	
29/06/12	x	x	x								x						x						3	
30/06/12	x	x		x							x						x			x			2	
01/07/12	x	x									x						x			x			4	
02/07/12	x	x		x						x							x			x			1	x
03/07/12	x		x	x							x					x				x			2	x
04/07/12	x			x																x			2	
05/07/12	x															x	x						1	
06/07/12	x		x														x						1	x
07/07/12	x		x														x			x			1	x
08/07/12	x																			x				x
09/07/12	x		x					x									x			x				
10/07/12	x	x						x								x	x							
11/07/12	x	x	x					x					x			x	x			x				x
12/07/12	x	x	x														x			x				x
13/07/12	x	x	x									x								x				
14/07/12	x				x															x				
15/07/12	x		x														x			x			1	
16/07/12	x	x	x					x									x			x				
17/07/12	x		x								x			x						x				
18/07/12	x	x	x					x									x			x				
19/07/12	x	x									x													
20/07/12	x		x					x	x	x							x			x				
21/07/12	x	x																						
22/07/12								x								x								
23/07/12	x	x														x	x	x						
24/07/12	x		x														x			x				